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(54) **FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING SAME**

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G03G 21/16 (2006.01)
G03G 15/20 (2006.01)

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CPC ***G03G 21/1685*** (2013.01); ***G03G 15/2053*** (2013.01); *G03G 2215/2035* (2013.01)

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CPC . G03G 15/20; G03G 15/206; G03G 15/2064; G03G 15/2089; G03G 21/1685
See application file for complete search history.

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(57) **ABSTRACT**

A fixing device capable of incorporating in an image forming apparatus includes a belt unit including a rotatable elastic endless belt having a sleeve shape without a driving shaft and a nip forming member disposed contactable against an inner surface of the endless belt, and a pressing member to form a nip contact portion through which a recording medium passes by pressing against the nip forming member via the endless belt. The endless belt is configured to be removable from the fixing device without contacting the endless belt.

20 Claims, 7 Drawing Sheets

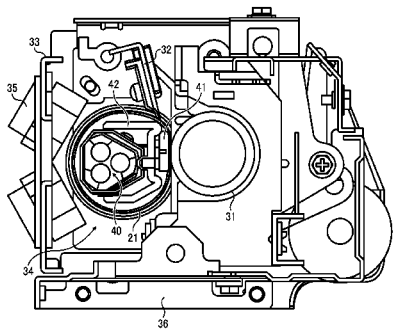

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FIG. 1
RELATED ART

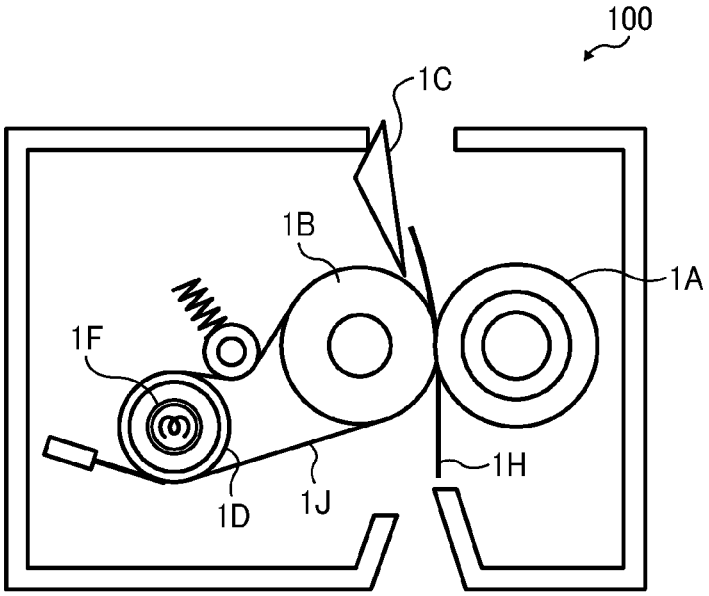
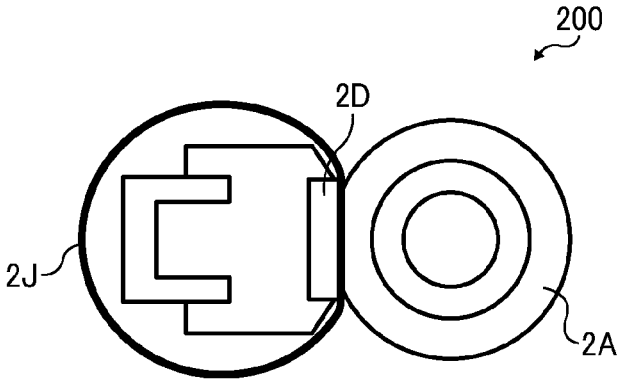
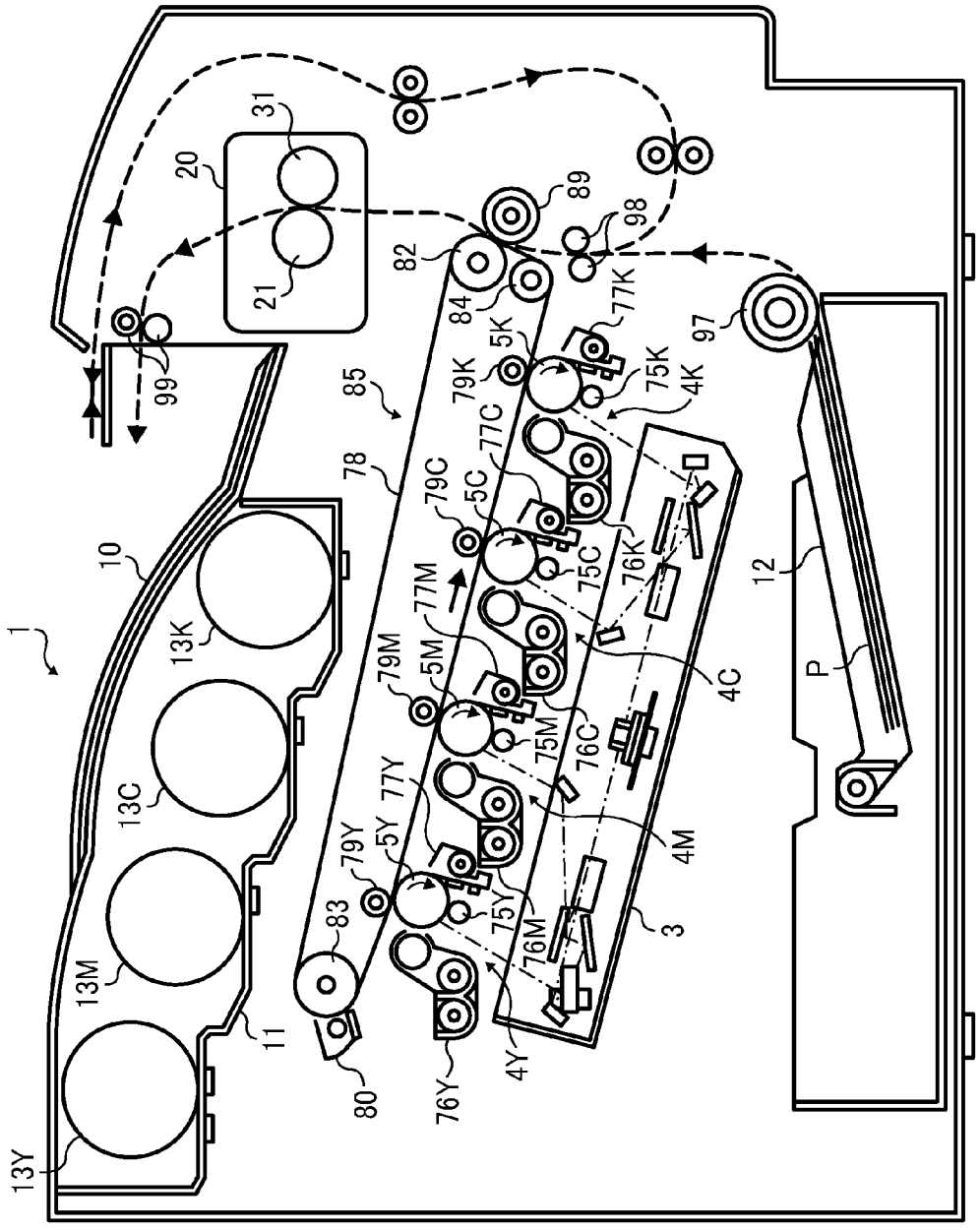


FIG. 2
RELATED ART

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13Y
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5C
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76Y
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76K
77Y
77M
77C
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FIG. 3

FIG. 4

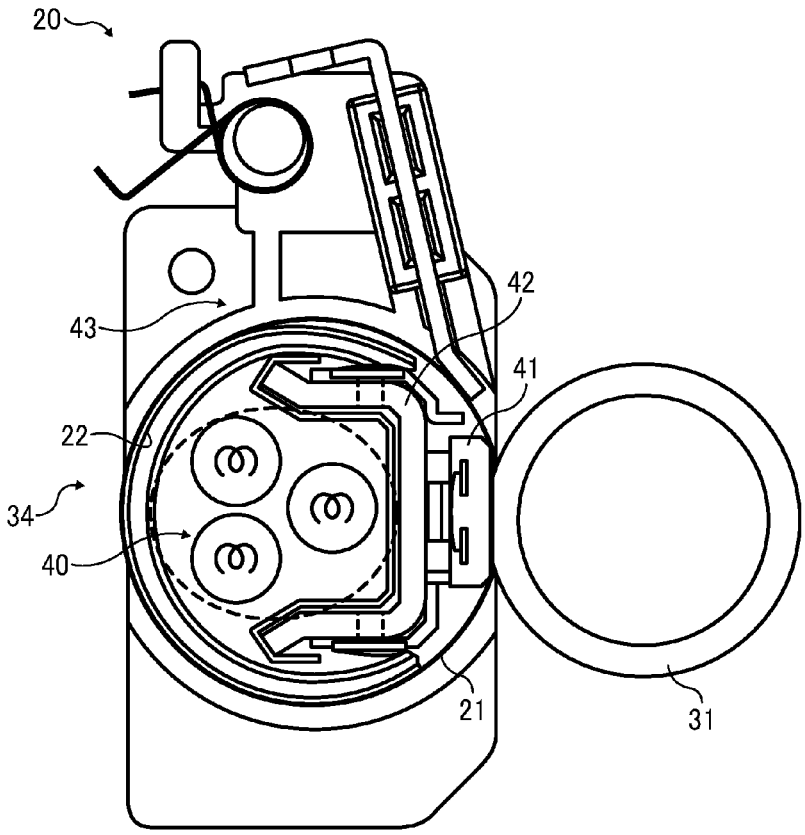


FIG. 5

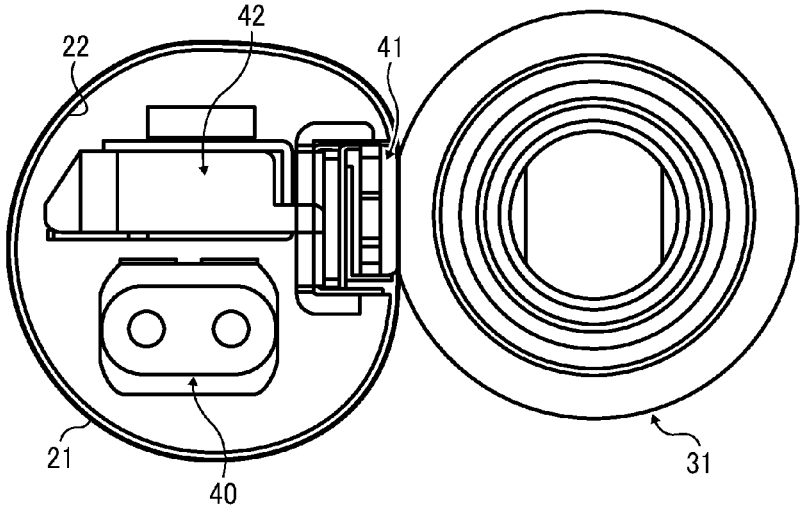


FIG. 6

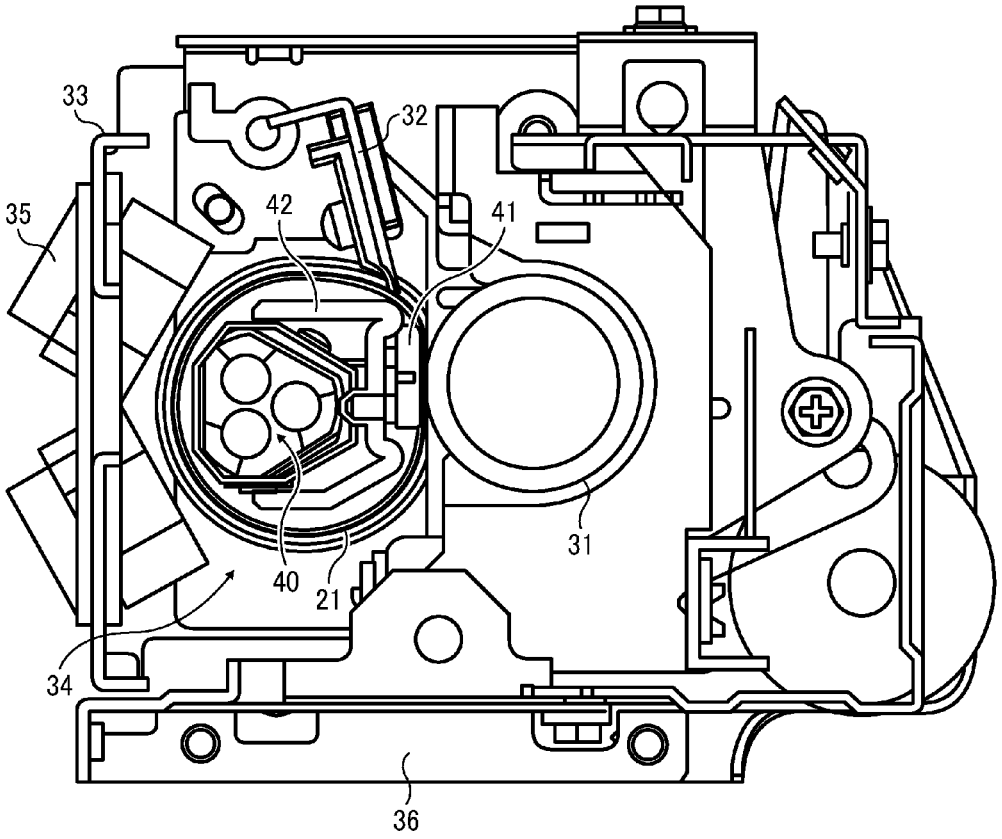


FIG. 7

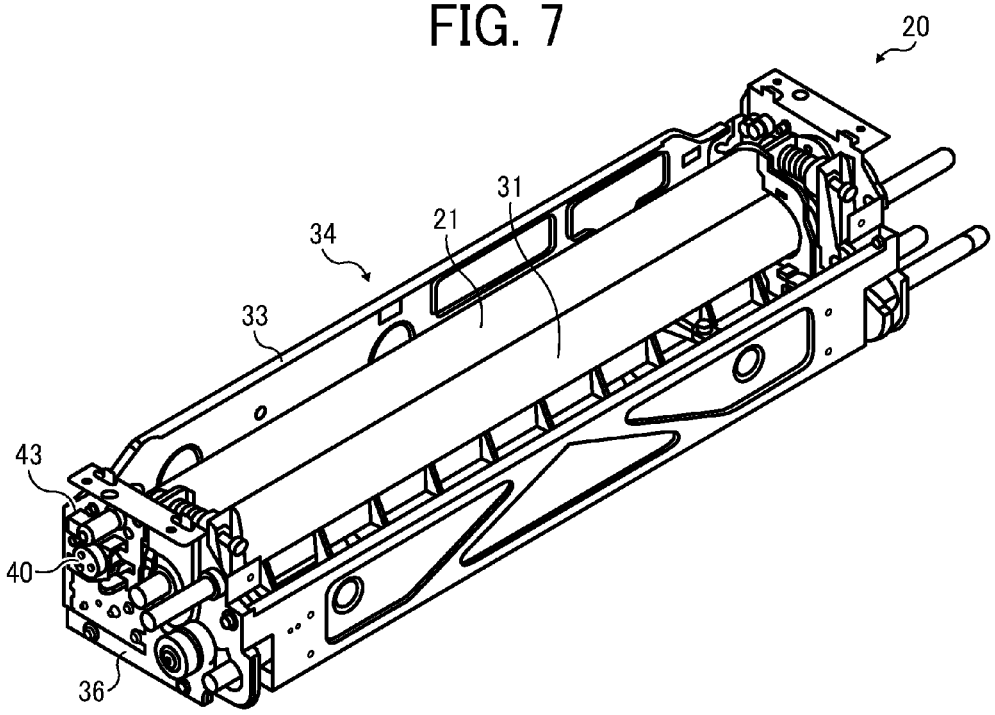


FIG. 8

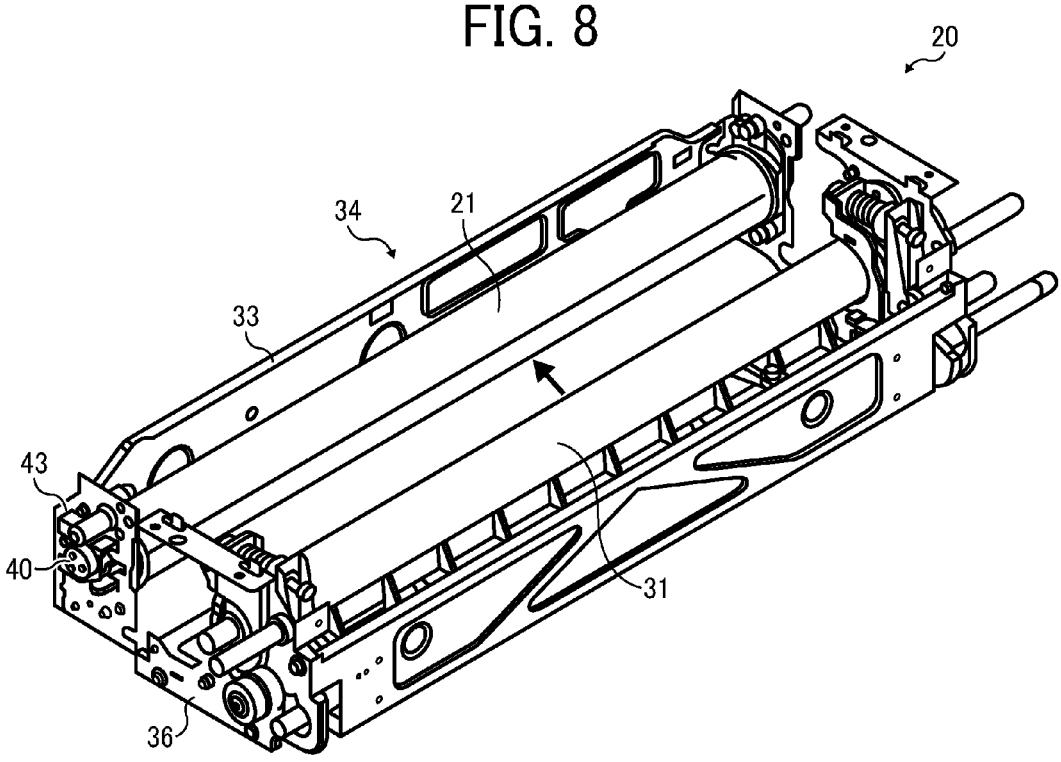


FIG. 9

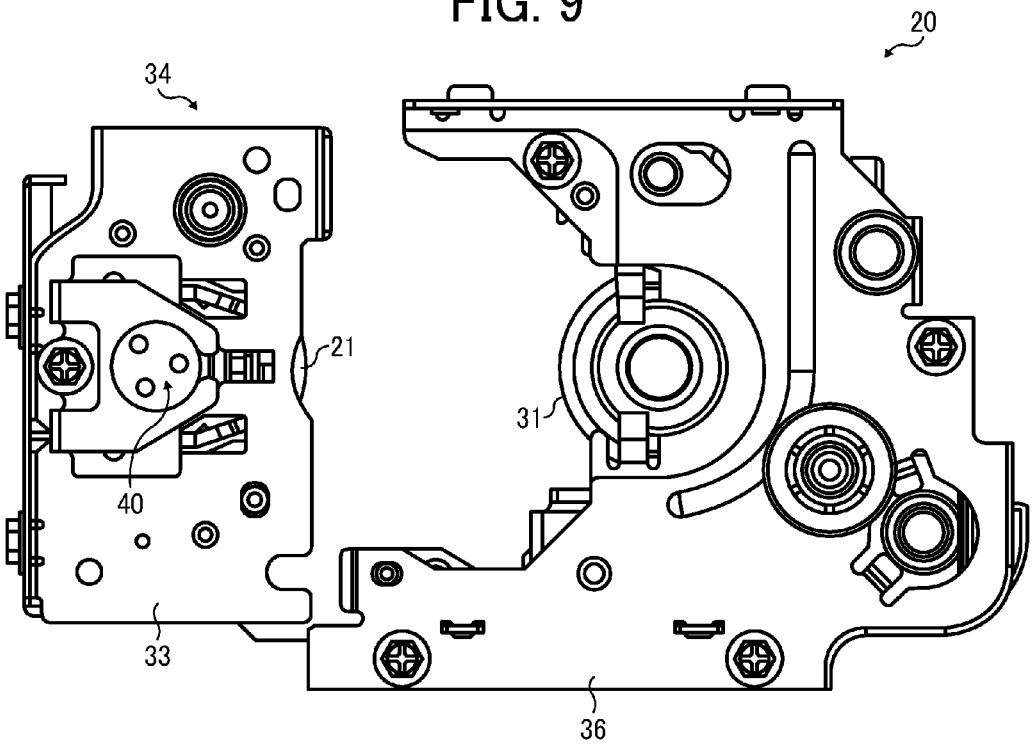


FIG. 10

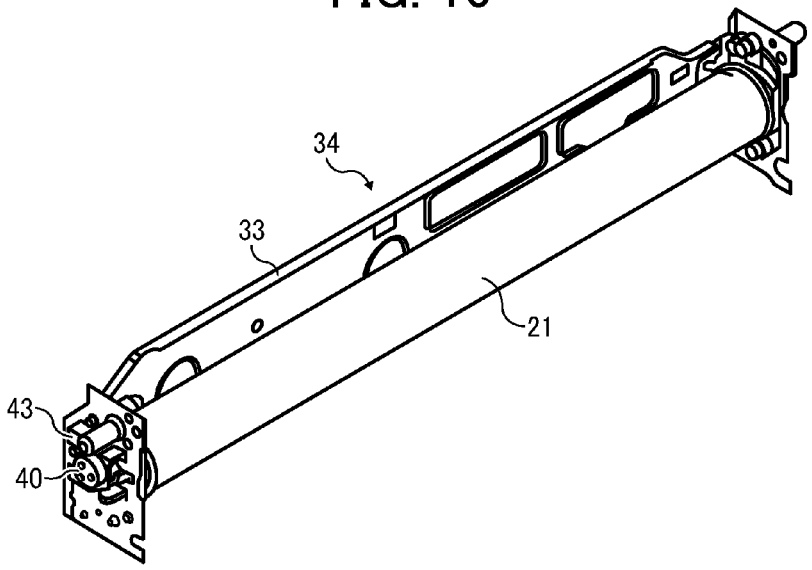
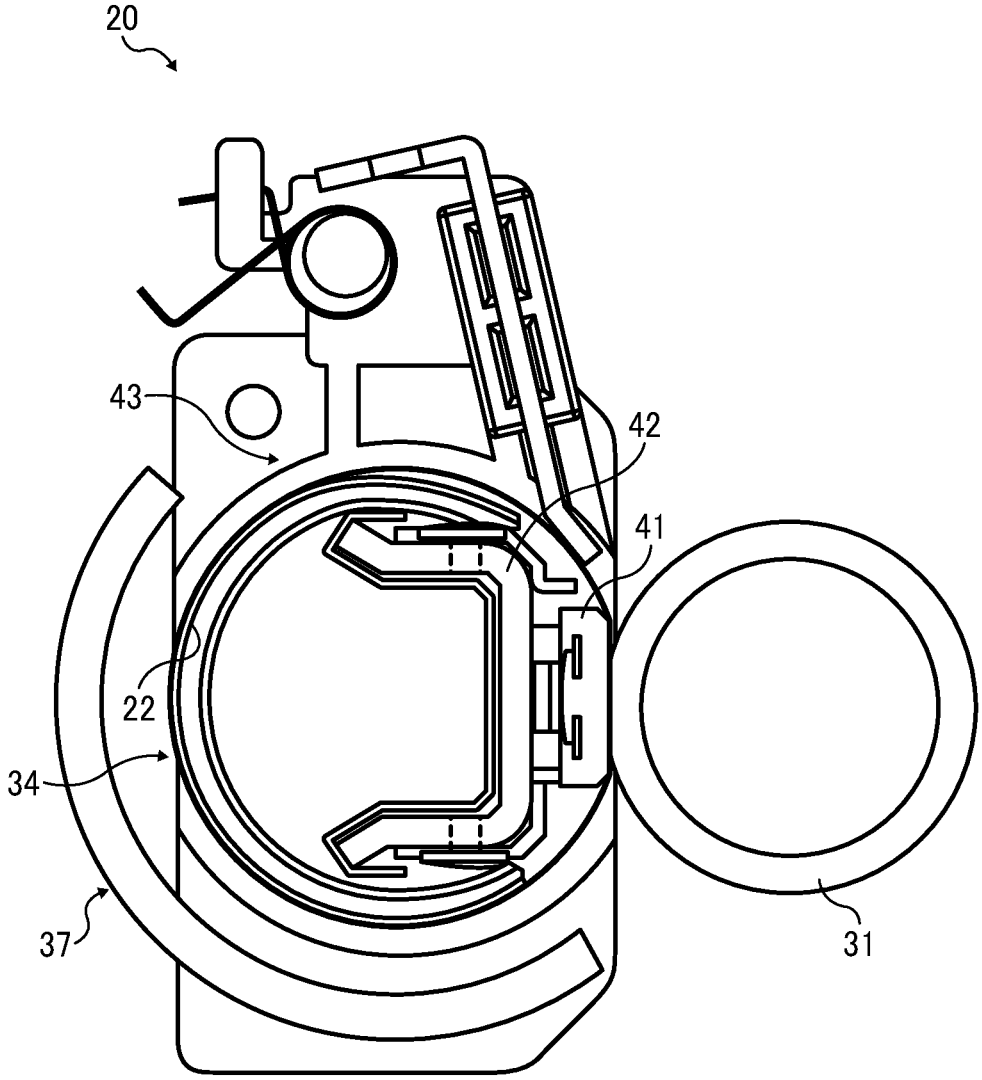


FIG. 11



FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING SAME

CROSS-REFERENCE TO RELATED APPLICATION

This patent application is based on and claims priority pursuant to 35 U.S.C. §119 to Japanese Patent Application No. 2012-026354, filed on Feb. 9, 2012, in the Japan Patent Office, the entire disclosure of which is hereby incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

Embodiments of the present invention relate to a fixing device that fixes an image to a recording medium and an image forming apparatus, such as a copier, a printer, a facsimile machine and a multifunctional device having functions of the copier, printer, and facsimile machine, which includes the fixing device.

2. Description of the Related Art

In the image forming processes performed for known electrophotographic image forming apparatuses, an electrostatic latent image is formed on the surface of a photoconductor drum that serves as an image carrier, developed into a visible toner image by applying a developer thereto, transferred onto a recording medium by a transfer device, and fixed to the recording medium by applying pressure and heat in a fixing device.

The fixing device includes two opposed rollers, a roller and a belt, or a rotary body that is a combination of the rollers or the roller and the belt to sandwich the recording medium therebetween and apply heat and pressure for fixing the toner image to the recording medium. For example, a known belt fixing unit as illustrated in FIG. **1** includes a fixing roller **1**B provided with a fixing belt **1**J and a pressure roller **1**A. The fixing belt **1**J includes a heat roller **1**D that has a heater **1**F serving as a heat source, and the fixing belt includes the fixing roller **1**B having a surface layer and a rubber layer. The pressure roller **1**A is disposed in contact with the fixing belt **1**B. After a recording medium **1**H having the transferred toner image thereon has arrived at a fixing device **100**, the recording medium **1**H is conveyed to a fixing nip contact portion formed between the fixing belt **1**J and the pressure roller **1**A. In the process in which the recording medium **1**H passes the fixing nip contact portion, the toner image transferred onto the recording medium **1**H is heated and pressed.

For another example, Japanese Patent Application Publication No. H04-44075 (JP-H04-044075-A) discloses a fixing device **200** that can be used for an image forming apparatus and includes a fixed member that slidably contacts an inner surface of the fixing member, as illustrated in FIG. **2**. This fixing device **200** includes a film heating system, in which a fixing nip contact portion is generally formed by sandwiching a fixing film made of heat-resistant film between a ceramic heater **2**F serving as a heating element and a pressure roller **2**A serving as a pressing member. A recording medium having an unfixed toner image is conveyed between the film and the pressure roller **2**A at the fixing nip contact portion, and is further conveyed together with the film, so that heat of the ceramic heater **2**F is applied at the fixing nip contact portion to the recording medium via the film. Further, the unfixed toner image is fixed to the surface of the recording medium by application of heat and the pressure exerted at the fixing nip contact portion.

The fixing device **200** employing the film heating system can include an on-demand type device using the ceramic heater **2**F and a low heat capacity member such as the film, and can power up the ceramic heater **2**F as a heat source in image formation of the image forming apparatus to ensure that the fixing device **200** is heated to the predetermined fixing temperature. Accordingly, a waiting period from power-on to standby for image formation is short (i.e., quick start) and power consumption during standby is greatly reduced.

For yet another example, Japanese Patent Application Publication No. H08-262903 (JP-H08-262903-A) discloses a fixing device employing a pressure belt. The fixing device includes a rotary heating/fixing roll whose surface is elastically deformed, an endless belt that is movable while it is contacting the heating/fixing roll, and a pressure pad that is non-rotatably disposed inside the endless belt to cause the endless belt to press against the heat fixing roller to form a belt nip contact portion between the endless belt and the heat fixing roller so that the recording medium can pass through the belt nip contact portion and can elastically deform the surface of the heat fixing roller. The fixing device using the pressure belt can increase the contact area of the heating/fixing roll with the recording medium, and therefore thermal conductivity of the fixing device can be enhanced and energy consumption can be reduced, thereby reducing the size of the fixing device and the image forming apparatus.

However, the fixing device disclosed in JP-H04-044075-A has insufficient wear resistance for sliding or moving between the ceramic heater **2**F as the heat source and the inner surface of the endless belt **2**J. For example, if the fixing device **200** is operated for an extended period of time, the inner surface of the endless belt **2**J suffers wear due to the friction of contact of the ceramic heater **2**F with the endless belt **2**J, thereby serving to increase frictional resistance. Accordingly, the movement of the endless belt **2**J becomes unstable or the drive torque of the fixing device **200** increases, adversely affecting conveyance of the recording media and causing image displacement. Further, stress on the driving gear can damage the gear train.

Further, the fixing device **200** employing the film heating system is configured to heat the belt at the nip contact portion locally. Therefore, when the belt rotates through the nip contact portion, the temperature of the endless belt **2**J is at its lowest and the endless belt **2**J has completely cooled down at the entrance to the nip contact portion, and therefore risk of fixing failure increases considerably. This effect becomes more pronounced when the endless belt **2**J is rotated at higher speed.

Meanwhile, to improve slidability of the inner surface of the belt and the fixed member, JP-H08-262903-A discloses a configuration of the fixing device in which an outer circumferential surface of the pressure pad is formed as a layer of a fiberglass sheet impregnating polytetrafluoroethylene (a PTFE-impregnated glass cloth) as a low-friction sheet. JP-H08-262903-A describes that the slidability can be enhanced with this method. However, in the fixing device employing the above-described pressure belt, the fixing roller has a large heat capacity, and therefore the temperature of the fixing device does not elevate quickly, which results in a long warm-up time.

To address the above-described problems, the inventors of the present invention have studied the fixing device that is disclosed in Japanese Patent Application Publication No. 2007-334205 (JP-2007-334205-A). This fixing device discloses technology in which the entire part of a sleeve endless belt is heated by a heat source disposed inside the belt, thereby

shortening a warm-up time of the fixing device. However, the sleeve endless belt includes the heat source therein and therefore does not have a drive shaft therein. With this configuration, the entire fixing unit needs to be replaced instead of just the endless belt, resulting in an increase in costs.

SUMMARY OF THE INVENTION

The present invention describes a novel fixing device including a belt unit including a rotatable elastic endless belt having a sleeve shape without a driving shaft and a nip forming member disposed contactable against an inner surface of the endless belt, and a pressing member to form a nip contact portion through which a recording medium passes by pressing against the nip forming member via the endless belt. The endless belt is configured to be removable from the fixing device without contacting the endless belt.

The above-described fixing device may further include a flange to hold the belt unit, and a belt unit stay to hold the flange. The belt unit may be configured to be removable by removing the belt unit stay.

The belt unit may include a heater therein to heat the endless belt, and the heater may be held by the belt unit stay.

The belt unit may further include a nip supporter to prevent deformation of the nip forming member due to pressure exerted by the pressing member. The nip supporter may be held by the belt unit stay.

The belt unit may include a nip supporter to prevent deformation of the nip forming member due to pressure exerted by the pressing member. The nip supporter may be held by the belt unit stay.

Further, a novel image forming apparatus includes an image carrier to form an image on a surface thereof, a transfer unit to transfer the image onto a recording medium, and the above-described fixing device.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

A more complete appreciation of the invention and many of the advantages thereof will be obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is a schematic diagram illustrating a configuration of a known fixing device;

FIG. **2** is a schematic diagram illustrating a configuration of another known fixing device;

FIG. **3** is a schematic diagram illustrating an image forming apparatus according to a first embodiment of the present invention;

FIG. **4** is a schematic cross-sectional view illustrating an example of a fixing device according to the first embodiment of the present invention, includable in the image forming apparatus of FIG. **3**;

FIG. **5** is a schematic cross-sectional view illustrating another example of the fixing device according to the first embodiment of the present invention, includable in the image forming apparatus of FIG. **3**;

FIG. **6** is a schematic cross-sectional view illustrating the fixing device according to the first embodiment of the present invention, includable in the image forming apparatus of FIG. **3**;

FIG. **7** is a schematic perspective view illustrating the fixing device according to the first embodiment of the present invention, includable in the image forming apparatus of FIG. **3**;

FIG. **8** is a schematic perspective view illustrating the fixing device according to the first embodiment of the present invention, in a state of disassembly;

FIG. **9** is a schematic side view illustrating the fixing device according to the first embodiment of the present invention, in a state of disassembly;

FIG. **10** is a schematic perspective view illustrating a belt unit according to the first embodiment of the present invention, included in the fixing device of the image forming apparatus of FIG. **3**; and

FIG. **11** is a cross-sectional view illustrating a fixing device according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

It will be understood that if an element or layer is referred to as being "on", "against", "connected to" or "coupled to" another element or layer, then it can be directly on, against, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, if an element is referred to as being "directly on", "directly connected to" or "directly coupled to" another element or layer, then there are no intervening elements or layers present. Like numbers referred to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

Spatially relative terms, such as "beneath", "below", "lower", "above", "upper" and the like may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements describes as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, term such as "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors herein interpreted accordingly.

Although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, it should be understood that these elements, components, regions, layer and/or sections should not be limited by these terms. These terms are used only to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes" and/or "including", when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Descriptions are given, with reference to the accompanying drawings, of examples, exemplary embodiments, modification of exemplary embodiments, etc., of an image forming apparatus according to the present invention. Elements having the same functions and shapes are denoted by the same

reference numerals throughout the specification and redundant descriptions are omitted. Elements that do not require descriptions may be omitted from the drawings as a matter of convenience. Reference numerals of elements extracted from the patent publications are in parentheses so as to be distinguished from those of exemplary embodiments of the present invention.

The present invention is applicable to any image forming apparatus, and is implemented in the most effective manner in an electrophotographic image forming apparatus.

In describing preferred embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of the present invention is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have the same function, operate in a similar manner, and achieve a similar result.

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, preferred embodiments of the present invention are described.

A description is give of a configuration of an image forming apparatus **1** according to a first embodiment of the present invention.

The image forming apparatus **1** that is a tandem-type color printer includes a toner bottle container **11** at an upper part thereof. The toner bottle container **11** contains four toner bottles **13**Y, **13**M, **13**C, and **13**K, which corresponds to respective single toner colors of yellow, magenta, cyan, and black. The toner bottles **13**Y, **13**M, **13**C, and **13**K are detachably attachable to the toner bottle container **11**.

An intermediate transfer unit **85** is disposed below the toner bottle container **11**. The intermediate transfer unit **85** includes an intermediate transfer belt **78** and image forming devices **4**Y, **4**M, **4**C, and **4**K disposed facing the intermediate transfer belt **78**.

The image forming devices **4**Y, **4**M, **4**C, and **4**K include photoconductive drums **5**Y, **5**M, **5**C, and **5**K, respectively. Further, a charging device **75**Y, a development device **76**Y, a cleaning unit **77**Y, and a non-illustrated discharging unit are arranged around the photoconductive drum **5**Y; a charging device **75**M, a development device **76**M, a cleaning unit **77**M, and a non-illustrated discharging unit are arranged around the photoconductive drum **5**M; a charging device **75**C, a development device **76**C, a cleaning unit **77**C, and a non-illustrated discharging unit are arranged around the photoconductive drum **5**C, and a charging device **75**K, a development device **76**K, a cleaning unit **77**K, and a non-illustrated discharging unit are arranged around the photoconductive drum **5**K. On each of the photoconductive drums **5**Y, **5**M, **5**C, and **5**K, image forming processes such as a charging process, an exposure process, a development process, a primary transfer process, and a cleaning process are performed, and as a result respective single color toner images are formed on the photoconductive drums **5**Y, **5**M, **5**C, and **5**K.

The elements or components of the image forming devices **4**M, **4**C, **4**Y, and **4**K are similar in structure and function to each other, except that the image forming devices **4**M, **4**C, **4**Y, and **4**K have different colors of toner, and therefore are also referred to as the image forming device **4** in a singular form.

In the charging process, the photoconductive drum **5** is rotated by a non-illustrated drive motor in a clockwise direction in FIG. **3** and the surface of the photoconductive drum **5** is uniformly charged at the charging unit **75**.

In the exposure process, the charged surface of the photoconductive drum **5** reaches a position to which a laser light beam is emitted from an exposure unit **3** so that an electrostatic latent image corresponding to the respective single toner color is formed thereon.

In the development process, the surface of the photoconductive drum **5** arrives at a position opposite to the development device **76** where the electrostatic latent image is developed into a visible toner image.

In the primary transfer process, the surface of the photoconductive drum **5** arrives at a position opposite to the intermediate transfer belt **78** and primary transfer bias rollers **79**Y, **79**M, **79**C, and **79**K where the toner image formed on the surface of the photoconductive drum **5** is transferred onto the developed onto the surface of the intermediate transfer belt **78**. At this time, residual toner remains on the surface of the photoconductive drum **5**.

In the cleaning process, the surface of the photoconductive drum **5** reaches a position opposite to the cleaning unit **77** where the residual toner remaining on the surface of the photoconductive drum **5** is removed by a cleaning blade included in the cleaning unit **77** and collected mechanically.

Finally, the surface of the photoconductive drum **5** reaches a position opposite to a non-illustrated discharging unit where a residual potential remaining on the photoconductive drum **5** is removed.

Thus, a series of image forming processes performed on the photoconductive drum **5** completes.

Thereafter, the toner images formed on the surfaces of the photoconductive drums **5** are sequentially transferred onto the intermediate transfer belt **78** so that a composite color image is formed on the intermediate transfer belt **78**, which is a secondary transfer process.

Here, an intermediate transfer unit **85** includes an intermediate transfer belt **78**, the primary transfer bias rollers **79**Y, **79**M, **79**C, and **79**K, a secondary transfer backup roller **82**, a cleaning backup roller **83**, a tension roller **84**, and an intermediate transfer cleaning unit **80**.

The intermediate transfer belt **78** is supportably wound around the secondary transfer backup roller **82**, the cleaning backup roller **83**, and the tension roller **84** with tension and is rotated with rotation of the secondary transfer backup roller **82** in a direction indicated by arrow in FIG. **3**.

The primary transfer bias roller **79** (i.e., the primary transfer bias rollers **79**Y, **79**M, **79**C, and **79**K) and the photoconductive drum **5** (i.e., the photoconductive drums **5**Y, **5**M, **5**C, and **5**K) interpose the intermediate transfer belt **78** therebetween to form a primary transfer nip contact portion. The primary transfer bias roller **79** is applied with a transfer bias that has an opposite polarity to the toner.

The intermediate transfer belt **78** travels in a direction indicated by arrow in FIG. **3**, and passes the respective primary transfer nip contact portions of the primary transfer bias rollers **79**Y, **79**M, **79**C, and **79**K sequentially. With this action, the respective single toner images formed on the surfaces of the photoconductive drums **5**Y, **5**M, **5**C, and **5**K are sequentially transferred onto the surface of the intermediate transfer belt **78** to form a composite toner image. The composite toner image on the intermediate transfer belt **78** comes to a position opposite to a secondary transfer roller **89**. At this position, the secondary transfer backup roller **82** and the secondary transfer roller **89** interpose the intermediate transfer belt **78** therebetween to form a secondary transfer nip contact portion. The four-color composite toner image formed on the surface of the intermediate transfer belt **78** is transferred onto the recording medium P that is conveyed to the secondary transfer nip contact portion. At this time, non-transferred residual toner remains on the surface of the intermediate transfer belt **78**. When the intermediate transfer belt

78 reaches the position near the intermediate transfer cleaning unit 80, the non-transferred residual toner on the intermediate transfer belt 78 is removed and collected.

With this action, the series of transfer processes performed on the intermediate transfer belt 78 completes.

The recording medium P conveyed to the secondary transfer nip contact portion has traveled from a sheet feeding unit 12 disposed at the lower part of the image forming apparatus 1 via a sheet feed roller 97, a pair of registration rollers 98, and so forth. The sheet feeding unit 12 accommodates a stack of recording media including the recording medium P such as a transfer sheet. When the sheet feed roller 97 is rotated in a direction counterclockwise to FIG. 3, an uppermost recording medium P is fed toward the rollers of the pair of registration rollers 98. The recording medium P conveyed to the pair of registration rollers 98 temporarily stops at the nip contact portion formed by the non-rotated pair of registration rollers 98. Then, the pair of registration rollers 98 rotates in synchronization with movement of the four-color toner image on the intermediate transfer belt 78, and the recording medium P travels toward the secondary transfer nip contact portion. By so doing, a desired color image is transferred onto the surface of the recording medium P. Then, the desired composite color image is transferred onto the recording medium P at the secondary transfer nip contact portion and the recording medium P is then conveyed by a fixing device 20. At the fixing device 20, the composite color image on the recording medium P is fixed to the recording medium P by application of heat and pressure. Then, the recording medium P is discharged by a pair of discharging rollers 99 to the outside of the image forming apparatus 1 and is stacked on a stacker 10 sequentially as an output image.

Next, a description is given of a configuration of the fixing device 20 with reference to FIG. 4.

As a first example, a fixing device 20 of FIG. 4 includes a pressure roller 31 serving as a pressure rotary member, a fixing belt 21, and a metallic pipe 22 that is disposed in the vicinity of an inner circumferential surface of the fixing belt 21. In FIG. 4, halogen heaters are used as heat sources 40 to heat the metallic pipe 22.

On the inner circumferential surface of the fixing belt 21 illustrated in FIG. 4, a nip forming member 41 is supported by the metallic pipe 22. The nip forming member 41 is configured to be slidable with the inner circumferential surface of the fixing belt 21 directly or via a slide sheet. In the configuration of the fixing device 20 illustrated in FIG. 4, the nip contact portion has a U shape. However, the shape of the nip contact portion is not limited thereto. For example, the nip contact portion can employ a flat shape as illustrated in FIG. 5, a concave or other shape. In the fixing device 20 illustrated in FIG. 4, however, the discharging direction of the leading edge of the recording medium P inclines to the pressure roller 31, and accordingly separation performance is improved when the nip contact portion is U shaped, which prevents paper jams. Accordingly, the U-shaped nip contact portion is preferable.

The pressure roller 31 includes a hollow metallic roller with an elastic layer and a release layer. The elastic layer is made of a silicone rubber. The release layer is made of PFA or PTFE, for example, and provided on the outer circumferential surface of the elastic layer to have a good releasing performance. The pressure roller 31 is driven to rotate by a not-illustrated drive source, such as a motor, provided to the image forming apparatus 1. When the pressure roller 31 is driven to rotate, drive force of the pressure roller 31 is transmitted to the fixing belt 21 in the nip contact portion, and thereby the fixing belt 21 is driven to rotate.

The pressure roller 31 is pressed contact with the fixing belt 21 by a non-illustrated biasing member such as a spring. In the area of contact between the pressure roller 31 and the fixing belt 21, the elastic layer of the pressure roller 31 deforms to form a nip contact portion having a predetermined width along a sheet feeding direction.

The pressure roller 31 can be a solid bar. However, since a hollow-shaped roller can reduce the heat capacity, and therefore it is preferable the pressure roller 31 has a hollow shape. Further, since the pressure roller 31 is hollow, a heat source, such as a halogen heater, etc., can be disposed inside the pressure roller 31.

The silicone rubber layer can be replaced with solid rubber. However, if the pressure roller 31 does not have a heater therein, a sponge rubber can be used alternatively because the sponge rubber can increase heat retention ability to prevent taking heat from the fixing belt 21.

The fixing belt 21 is a sleeve-shaped belt or a film including a metal such as nickel, stainless steel, etc. or a resin material such as polyimide, etc. On the outer circumferential side of the fixing belt 21, a releasing layer such as tetrafluoroethylene-par fluoroalkyl vinyl ether copolymer (PFA) or polytetrafluoroethylene (PTFE) and the like is provided. The releasing layer has releasing performance so that toner does not adhere thereto. Further, an elastic layer made of rubber, such as silicone rubber may intervene between a base member and the releasing layer of PFA or PTFE. When the elastic layer is not present, the heat capacity is reduced and the fixing ability is enhanced. On the other hand, however, an unfixed image is crushed to be fixed, fine unevenness on the surface of the fixing belt 21 is transferred onto an image and unevenness of gloss in an orange peel state (e.g., an orange peel image) remains in the solid image. To further effectively prevent such skin-like glossy irregularity, the elastic rubber preferably has a given thickness, for example 100 μm or more. As the elastic layer deforms, the fine unevenness on the surface of the fixing belt 21 is absorbed, thereby improving the orange peel image.

The metallic pipe 22 is made of a metal such as aluminum, iron, stainless steel, and the like. As illustrated in FIG. 4, the metallic pipe 22 is formed into a substantially C-shaped member in cross-section having an opening at a position corresponding to the nip forming member 41. However, the shape of the metallic pipe 22 is not limited thereto and can be a substantially square member or other members having other shapes in cross-section. The metallic pipe 22 includes a nip supporting member 42 inside to support the nip forming member 41.

The configuration of the nip supporting member 42 prevents the nip forming member 41 from being bent by the pressure applied by the pressure roller 31, thereby maintaining a uniform nip width in the axial direction of the pressure roller 31.

The nip supporting member 42 and the nip forming member 41 are fixed and positioned by a flange 43 at both end portions thereof. The flange 43 functions as a moving guide for holding and guiding both end portions of the fixing belt 21. When the nip supporting member 42 is heated by radiant heat generated by the halogen heaters 40 and so forth, excessive heating can be prevented by applying heat insulation of, or giving a mirror-finish to, the surface of the nip supporting member 42, thereby preventing unnecessary energy consumption.

In FIG. 4, halogen heaters are employed as the heat sources 40 for heating the metallic pipe 22. However, the heat source 40 is not limited thereto. For example, the heat source 40 can employ induction heating, resistance heating element, carbon heater and the like.

The fixing belt **21** rotates along with rotation of the pressure roller **31**. Specifically, as illustrated in FIG. **4**, the pressure roller **31** is configured to be driven to rotate by a non-illustrated drive source and the driving force of the pressure roller **31** is transmitted to the fixing belt **21** in the nip contact portion, thereby rotating the fixing belt **21**. While being sandwiched in the nip contact portion, the fixing belt **21** is guided by the flange **43** in an area other than the nip contact portion so that the fixing belt **21** can remain at a predetermined distance from the heat sources **40**. Lubricant such as silicone oil or fluorine grease may be applied to the interface between the fixing belt **21** and the metallic pipe **22**. Accordingly, the above-described configuration can provide an inexpensive fixing device with a quick warm-up time and a stable temperature of the entire fixing belt **21**.

As another configuration applicable to the present invention, a fixing device without the metallic pipe **22** can be used. By not using the metallic pipe **22**, the heat sources **40** can directly heat the fixing belt **21**, and therefore a shorter warm-up time can be achieved, thereby obtaining good energy conservation.

Next, a description is given of details of the first embodiment.

As illustrated in FIG. **6**, the fixing belt **21** that is a sleeve belt without a driving shaft is slidably supported by a flange **43** having a groove at the inner surface of both ends. A separator **32** is supported by fitted to the groove of the flange **43**. The nip forming member **41** disposed inside the loop of the fixing belt **21** is supported by the nip supporting member **42**. The nip supporting member **42**, the flange **43**, and the heat sources **40** are all supported by a belt unit stay **33** that is supported by the frame **36** of the fixing device **20**. The fixing belt **21**, the nip forming member **41**, the nip supporting member **42**, and the heat sources **40** form a belt unit **34**.

FIGS. **7** and **8** are perspective views illustrating the fixing device **20** viewed from the pressure roller **31**.

In the first embodiment of the present invention, the fixing device **20** is fixed and positioned to the image forming apparatus **1** by screwing the belt unit stay **33** to the frame **36** fixed to the image forming apparatus **1**. To remove the belt unit **34** from the frame **36** for replacement, the belt unit stay **33** can be detached from the frame **36** easily by unscrewing the belt unit stay **33** from the frame **36**, as illustrated in FIGS. **8** and **9**.

Then, the separator **32** is removed from the belt unit stay **33** detached from the frame **36**. As previously described, the separator **32** is just fitted to the groove of the flange **43**, and therefore can be removed from the belt unit stay **33** easily.

Further, in the first embodiment of the present invention, electrical parts and/components such as the heat sources **40**, temperature sensors, drawer connectors, etc., are integrally supported by an electric parts supporting unit **35** (see FIG. **6**). The electric parts supporting unit **35** can be easily removed by unscrewing it from the belt unit stay **33**. Accordingly, the belt unit **34** can be completed separated from the other units and components of the image forming apparatus **1**, as illustrated in FIG. **10**. As a result, inadvertent contact with the fixing belt **21** and glass tubes of the heat sources **40**, which are likely to be damaged or broken during replacement, can be prevented. Moreover, the positions of the fixing belt **21** and the heat sources **40** with respect to the belt unit stay **33** are fixed, thereby facilitating replacement of the belt unit **34** reliably, without damaging or breaking the fixing belt **21** and/or the heat sources **40**. Accordingly, this configuration can achieve a reduction in the warm-up time of the fixing unit **20** and the image forming apparatus **1** and a cost-effective replacement of the belt unit **34**.

After the replacement, the user attaches the separator **32** and the electric parts supporting member **35** to the belt unit **34** held by the belt unit stay **33**, and installs the units in the reverse order of removal of the belt unit **34** from the fixing device **20**.

In the first embodiment of the present invention, a halogen heater is employed for a heat source. However, the configuration of the fixing device according to the present invention is not limited thereto. For example, a second embodiment of the present invention can provide a configuration including a ceramic heater at the nip contact portion, a configuration including a flat heater that is flexible and fixedly attached to an inner surface of a heating member, and a configuration including an induction heating (1H) heater **37** as illustrated in FIG. **11**.

The above-described embodiments are illustrative and do not limit the present invention. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, elements at least one of features of different illustrative and exemplary embodiments herein may be combined with each other at least one of substituted for each other within the scope of this disclosure and appended claims. Further, features of components of the embodiments, such as the number, the position, and the shape are not limited the embodiments and thus may be preferably set. It is therefore to be understood that within the scope of the appended claims, the disclosure of the present invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. A fixing device comprising:
a frame;
a belt unit including a rotatable elastic endless belt having a sleeve shape and a nip forming member disposed contactable against an inner surface of the endless belt, the belt unit being without a driving shaft;
a pressing member, disposed in the frame, to form a nip contact portion through which a recording medium passes by pressing against the nip forming member via the endless belt;
a flange to hold the belt unit;
a belt unit stay provided on the belt unit to support the nip forming member, the endless belt, and the flange, the belt unit being configured to be replaced by removing the belt unit stay from the frame of the fixing device; and
an electric parts supporting unit to support electrical parts disposed on the electric parts supporting unit, the electric parts supporting unit being configured to be removed from the belt unit stay while the belt unit is in a state that is configured to carry out a fixing operation.

2. The fixing device according to claim **1**,
wherein the belt unit comprises a heater therein to heat the endless belt,
wherein the heater is held by the belt unit stay.

3. The fixing device according to claim **2**,
wherein the belt unit further comprises a nip supporter to prevent deformation of the nip forming member due to pressure exerted by the pressing member,
wherein the nip supporter is held by the belt unit stay.

4. The fixing device according to claim **1**,
wherein the belt unit comprises a nip supporter to prevent deformation of the nip forming member due to pressure exerted by the pressing member,
wherein the nip supporter is held by the belt unit stay.

5. An image forming apparatus comprising:
an image carrier to form an image on a surface thereof;
a transfer unit to transfer the image onto a recording medium; and
the fixing device according to claim **1**.

6. The fixing device according to claim 1, wherein the flange acts as a moving guide for holding and guide both end portion of the endless belt.

7. The fixing device according to claim 1, wherein the endless belt is slidably supported by the flange having a groove at an inner surface of both ends.

8. The fixing device according to claim 1, wherein the endless belt is guided by the flange in an area other than the nip contact portion so that the endless belt can remain at a set distance from a heater.

9. The fixing device according to claim 1, wherein belt unit stay is supported by the frame of the fixing device.

10. The fixing device according to claim 9, wherein the belt unit stay is attached/detached from the frame.

11. The fixing device according to claim 1, wherein the separator is fitted to the flange.

12. The fixing device according to claim 1, further comprising a separator removable from the belt unit stay.

13. The fixing device according to claim 1, wherein, after replacement of the belt unit, the separator and the electric parts supporting unit are re-attached to the belt unit stay in reverse order of removal of the belt unit from the fixing device.

14. The fixing device according to claim 1, wherein the belt unit is configured to be replaced by unscrewing the belt unit stay from the frame of the fixing device.

15. A fixing device comprising:

a belt unit including

a rotatable endless in a loop, and

a nip forming member disposed contactable against an inner surface of the rotatable endless belt;

a pressing member to form a nip contact portion through which a recording medium passes by pressing against the nip forming member via the rotatable endless belt; a flange to hold the belt unit;

a belt unit stay to hold the flange such that the belt unit is removable by removing the belt unit stay; and

an electric parts supporting unit to support electrical parts,

wherein the belt unit is removable from the fixing device without contacting the rotatable endless belt, and

wherein the electric parts supporting unit is disposed outside a circumference of the rotatable endless belt, and is removable from the belt unit stay of which the belt unit is supported by the belt unit stay.

16. The fixing device according to claim 15, wherein the rotatable endless belt includes a heater lamp disposed inside the loop.

17. The fixing device according to claim 15, wherein the electric parts include at least one of a heat source, a temperature sensor, and a drawer connector.

18. The fixing device according to claim 15, wherein the belt unit further comprises a nip supporter to prevent deformation of the nip forming member due to pressure exerted by the pressing member, and

wherein the nip supporter is held by the belt unit stay.

19. The fixing device according to claim 15, wherein the rotatable endless belt is guided by the flange in an area other than the nip contact portion such that the endless belt remains at a predetermined distance from a heater.

20. An image forming apparatus comprising:

an image carrier to form an image on a surface thereof;

a transfer unit to transfer the image onto the recording medium; and

the fixing device according to claim 18.

* * * * *